

# What Is Information Visualization?

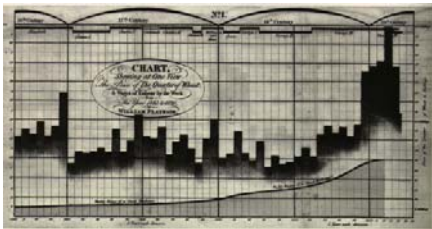
INFO 424  
 October 3, 2006  
 Polle Zellweger

## Overview

- ◆ Examples of information presentation
- ◆ Define
  - ❖ information visualization
  - ❖ information visualization process
  - ❖ information visualization tools
- ◆ Examples of info vis tools
- ◆ Designing a sample info vis tool

## William Playfair, 1786

- ◆ Published the first presentation graphics



## Dr. John Snow, 1845

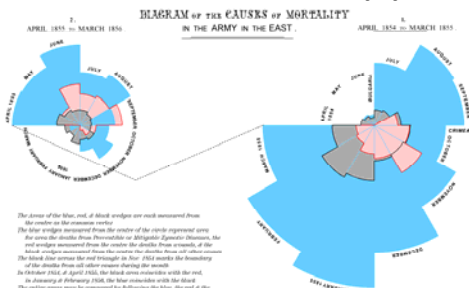
- ◆ London cholera epidemic



## Florence Nightingale, 1858

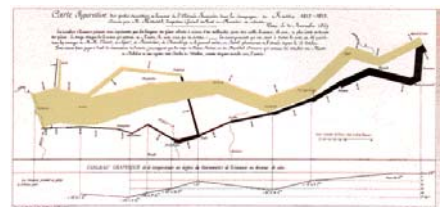
- ◆ Report about army deaths in the Crimean War

<http://www.florence-nightingale.org/eng/eng.html> see also [www.florence-nightingale.co.uk/small.htm](http://www.florence-nightingale.co.uk/small.htm)



## Charles Minard, 1869

- ◆ Napoleon's march



## Harry Beck, 1931

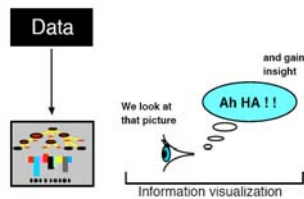
- ◆ London Underground schematic map



## Definition of Information Visualization (Spence)

- ◆ *Visualize:*
  - ❖ to form a mental model or image of something
- ◆ Information visualization:
  - ❖ the process of forming a mental model of information
- ◆ Important characteristics
  - ❖ a human cognitive activity
  - ❖ independent of computers
  - ❖ may involve senses other than seeing: sound, touch,...

## Spence's Information Visualization Model



Principal task of information visualization:  
allow *information* to be derived from *data*

## Computers and Information Visualization

- ◆ Principal task of information visualization:
  - ❖ allow *information* to be derived from *data*
- ◆ Computer technology has enabled major advances:
  - ❖ reductions in *memory cost & speed*
    - encouraged data storage in business, government, ...
  - ❖ increases in *computation speed & power*
    - support rapid selection of data to display
    - allow interactive computation of views
  - ❖ *high-resolution graphical displays*
    - allow views that match the power and characteristics of human perception & cognition

## Types of Data

- ◆ Quantitative
  - ❖ 1, -40, 12, 3.14159, 98.6, ...
- ◆ Ordinal
  - ❖ Monday, Tuesday, Wednesday, Thursday, ...
- ◆ Categorical
  - ❖ Oregon, Washington, California, ...
  - ❖ includes text
- ◆ Relationships
  - ❖ Picadilly Circus connected to Leicester Square on blue line

## Information Visualization Tools

- ◆ An *information visualization tool* is a computer-based\* system designed to display visually\* encoded data in order to support the process of information visualization

\* usually

## Example: Circuit Design, 1971

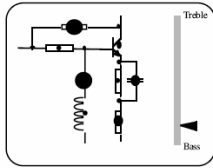
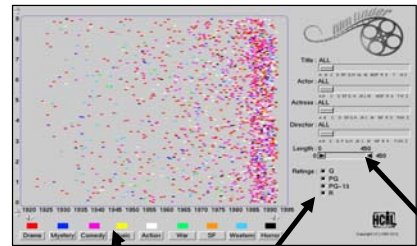


Figure 1.9 Circle size encodes the influence of components on the performance of a circuit

◆ Video

## Example: FilmFinder, 1994

◆ Ahlberg & Shneiderman, U of Maryland [Video](#)



Nominal: Color    Ordinal: List    Quantitative: Axis

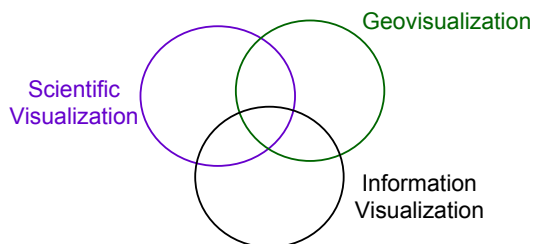
## The Human User

- ◆ How *people* interact with data determines how to best encode and present it
- ◆ Relevant human characteristics
  - ❖ perceptual processing
    - color, size, shape, ...
  - ❖ cognitive processing
    - memory, ...

## Principal Components of Information Visualization

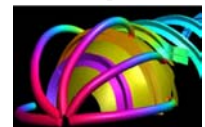
- ◆ Representation
  - ❖ how the data is encoded
  - ❖ usually in visual form
- ◆ Presentation
  - ❖ how suitably encoded data is laid out in:
    - available display area
    - time
- ◆ Interaction
  - ❖ actions performed by user to move from one view of the data to another

## Visualization History / Taxonomy



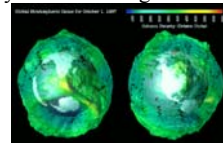
## Scientific Visualization

◆ Stress tensor in flow past hemisphere cylinder



[Lavin, 1997]

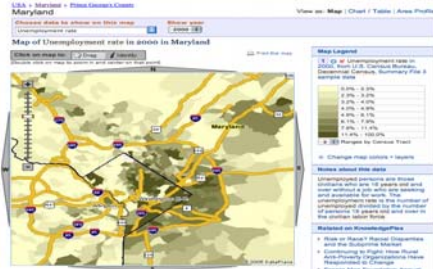
◆ Ozone layer surrounding the earth



[Treinish, 1995]

## Geovisualization

### ◆ Geographical display of unemployment data



[Fannie Mae DataPlace, 2000]

## Information Visualization

### ◆ SmartMoney's Map of the Market



<http://www.smartmoney.com/marketmap/marketmap.html>

## Data Domains for InfoVis

- ◆ Financial/business
- ◆ Statistics
- ◆ Software
- ◆ Text
- ◆ W W W
- ◆ ...

## Designing a Sample Visualization Tool

- ◆ Selecting a car to buy
  - ❖ choosing one item from many based on attributes
- ◆ Layered design study
- ◆ *Note:* selection criteria often...
  - ❖ imprecise
  - ❖ not known at the outset

### ◆ Car data

- ❖ cars + attributes
- (rows) (columns)

Make	Price (\$)	MPG	Rating	Age (yrs)
Ford	15492	31	****	3
Chevy	12492	27	***	4

### ◆ Creating an overview of prices

- ❖ bargram
- Price \$k

10 - 12	12 - 14	16 - 18
---------	---------	---------

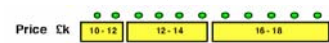
- ❖ length proportional to number of cars in each subrange

### ◆ Car appearance

- ❖ object vector of car icons



### ◆ Showing individual cars on bargrams



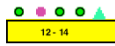
### ◆ Color coding to link car icons to bargrams



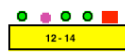
### ◆ Works for multiple bargrams



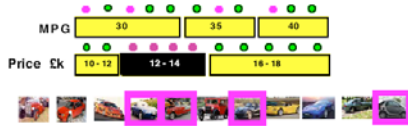
- ◆ Showing an “ideal” car



- ◆ Tagging a car for future reference



- ◆ Interactive selection of a bargram price range



- ◆ Selecting a second bargram range shows cars satisfying both criteria

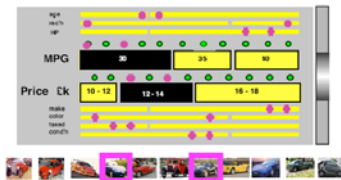


- ◆ Scrolling bargrams through a window allows display of many bargrams, or on a smaller device



- ◆ Handling limited space or many bargrams #2

- ❖ user selects which bargrams to view



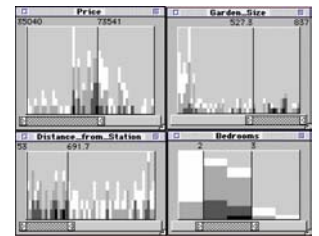
- ◆ Focusing on a single price range



## Attribute Explorer, 1998

- ◆ Spence & Tweedie, Imperial College

- ◆ [Video](#)

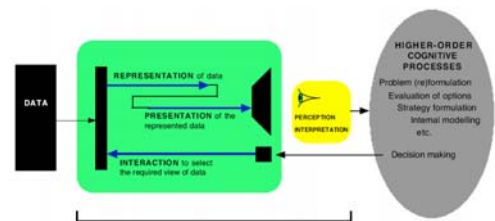


- ◆ Shows exploration for house purchase
- ◆ Dynamic querying by direct manipulation
- ◆ Color-encoded query sensitivity information

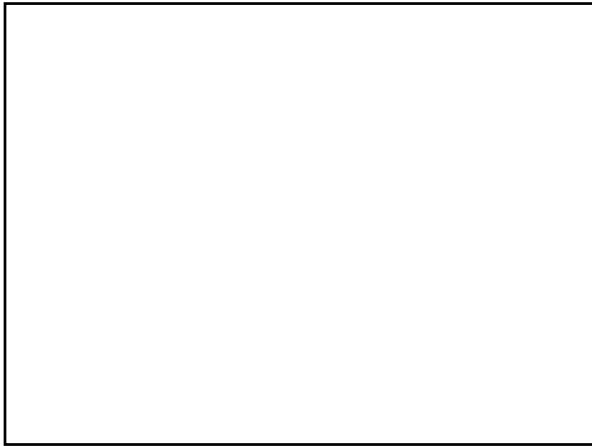
## Interactive Examples

- ◆ [U of Maryland Viz4All examples](#)

## Elements of Information Visualization



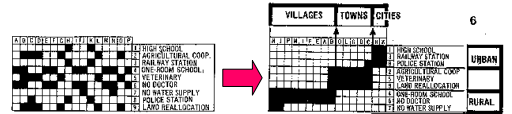
The scope of Spence 2006



## Jacques Bertin, 1967



- ◆ “The Semiology of Graphics”
- ◆ Permutation Matrices
  - ❖ a machine for interactive data exploration
  - ❖ also used a computer



## Example: Circuit Design, 1974

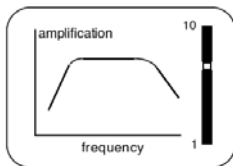


Figure 1.10 An interface permitting dynamic exploration of the effect of a component value on a circuit property

◆ [Video](#)